STUDY OF OLFACTORY FUNCTION IN PATIENTS WITH PARKINSON'S DISEASE AND HEALTHY PEOPLE

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Abstract

We studied the relations between odor sensitivity and Parkinsonism, In particular, Sniffin' sticks test has been used. The test comprises three subtests; it was shown the first one fails to reveal sick patients from healthy ones, while the second and the third work well. Reliable discrimination of healthy people from those with Parkinsonism was observed. Also, the second and the third subtests identify few healthy persons that may form a group at risk.

Introduction

Parkinson's disease (PD) is one of the most wide spread neurological disorders. Olfactory dysfunction is stipulated to be the first manifest of PD often preceding the movement disorders. A study of smell perception regardless pathology, or a norm makes itself the problem, since that former has not proper lexicon [1]. In spite of that, a number of attempts are made to implement smell perception data into a diagnostics and clinic practice.

Here we present some results on the implementation of olfactory dysfunction testing for the purposes of early diagnostics of Parkinson's disease. General invalidity of the first subtest of Sniffin' sticks test has been found and approved. On the contrary, the second subtest and the third subtest showed good performance in differentiation of healthy (control) population from sick one (PD patients). The second subtest effectively identifies healthy subpopulation, while gathers some healthy persons and sick ones into a cluster. Reciprocally, the third subtest yields good performance in identification of sick patients clustering them into three distinct clusters (of lower abundance), while the healthy population comprises a sparse extended cluster "deteriorated" with few sick patients.

Methods and Materials

An examination procedure was based on extended olfactory Sniffin' sticks test ("Burghart Messtechnik"™, Germany) to determine three parameters: threshold, identification and discrimination.

The testee set comprises patients suffering from PD, and conditionally healthy people, for testing verification. Totally, 33 men and 31 women conditionally healthy persons aged from 20 to 79 have been tested. Totally, 45 patients aged from 35 to 78 with PD have been enrolled into the study: 15 men and 30 women.

Healthy persons with the following features have been excluded from the study:
– those having inflammatory diseases of the nasal mucosa and sinuses;
– the presence of neurological symptoms and neurological diseases in medical records.

Any PD patients having some other neurological diseases besides Parkinsonism have been excluded from the study, as well.

Table 1. Results of healthy people of different ages.

Age range and sex	Number of subjects	Average age	Threshold	Discrimination	Identification	Total result
Up to 40 years	27	30,30	6,56	12,44	11,85	30,85
Men	21	30,81	6,95	12,29	11,43	30,67
Women	6	28,50	5,17	13,00	13,33	31,50
41-65 years	25	55,48	4,68	12,04	11,52	28,24
Men	7	55,50	4,78	12,44	11,83	29,06
Women	18	55,43	4,43	11,00	10,71	26,14
66 years and older	12	69,00	2,75	8,42	9,50	20,67
Men	5	67,20	2,60	9,60	9,40	21,60
Women	7	70,29	2,86	7,57	9,57	20,00

Table 2. Comparison of the results of healthy people and PD patients.

	Threshold	Discrimination	Identification		Total amount
	Average result	Average result	Average result	Odor knowledge	
Healthy people	5,11 ± 2,32	11,53 ± 2,28	11,28 ± 2,18	Best: garlic Worse: lemon and liquorice	Anosmia-3 Hyposmia-32 Norm-29
PD patients	2,44 ± 1,91	8,76 ± 2,47	6,87 ± 2,69	Best: fish Worse: lemon and apple	Anosmia-14 Hyposmia-30 Norm-1

Results

Here we present some results on the adoption of olfactory disfunction measurements for the purposes of early diagnostics of Parkinson's disease. To do that, we followed the approved and standard Sniffin' stick test [2, 3, 4]. Each testee could score: maximum points – 48; above 30 points – norm; 17-29 points – hyposmia; below 16 points - anosmia.

First, we tested only healthy people (Tab. 1) and here some results:
- The older the age, the worse the test scores;
- In the middle age group, women have better results than men.

Then we tested PD patients and compare their results with healthy people (Tab. 2).

Also we used elastic map technique to cluster and analyze data. To begin with, no clustering has been observed over the data of the first test (threshold). To verify the fact, we used K-means technique to check clustering; again, no pattern has been revealed. On the contrary, both the second and the third tests (discrimination and identification) showed rather good performance in differentiation of PD patients from healthy people. To do it, we developed elastic map showing the distribution of the points, corresponding to the testees (Fig. 1).
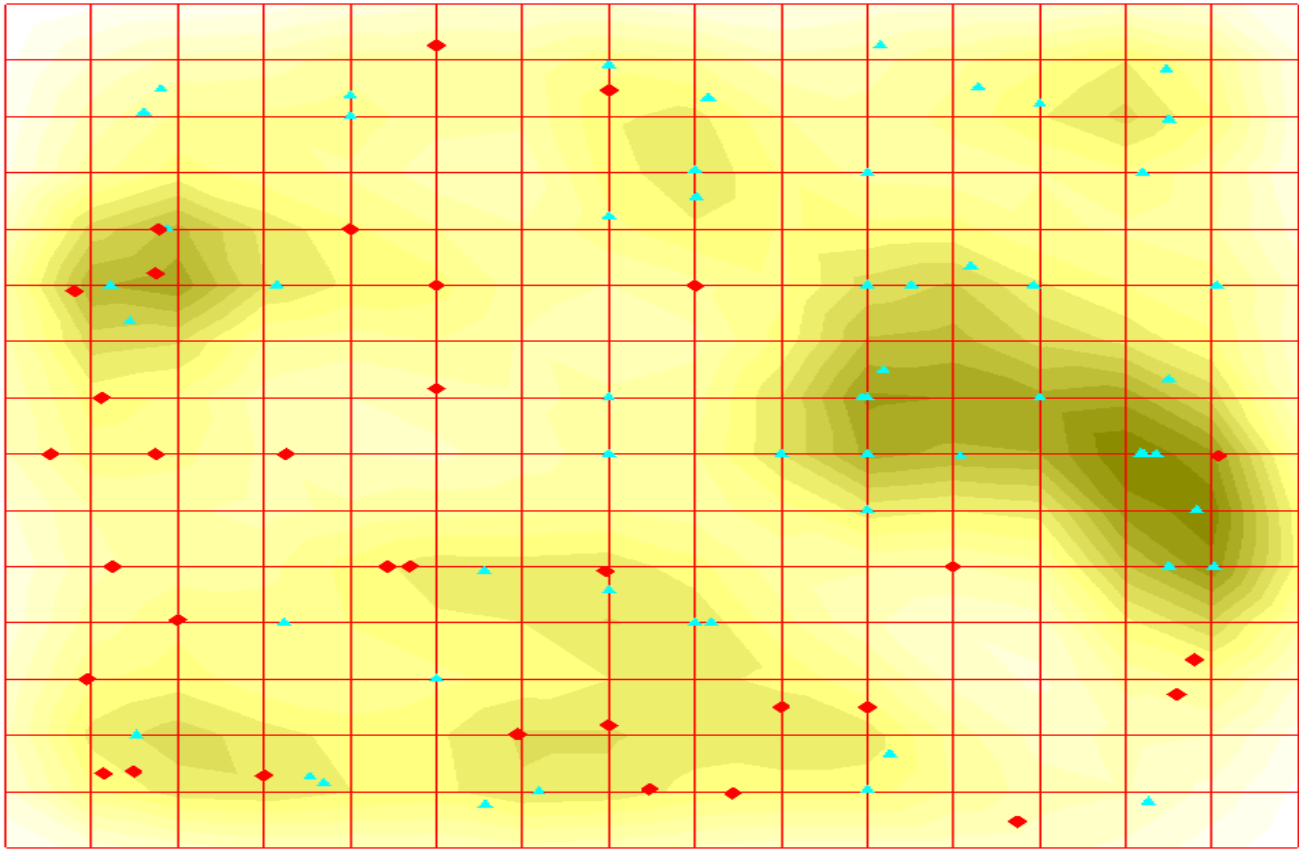

Figure 1. Distribution of testees over the elastic map. Red rhombus represent PD patients and turquoise triangles represent healthy people.

Discussion

We assume that the key problem of the first test (threshold) arises from the general psychological problem with deep evolutionary and biological roots: no language worldwide has specific ("own" or proper) lexicon to describe smell world [1]. In simple words, everything related to sense of smell falls beyond (rational) consciousness.

Another problem arises from human consciousness resulting in inability to behave randomly.

Thus, the first test of Sniffin' sticks test may not be interpreted correctly, unless the impact of two factors described above is implemented into the protocol.
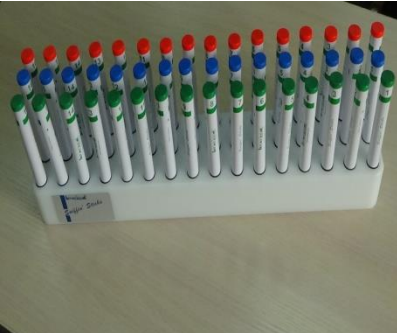

Figure 2. Threshold   **Figure 3.** Discrimination   **Figure 4.** Identification

Conclusions

Sniffin' sticks test may bring a lot into the early diagnostics and identification of PD. Especially the second and the third tests have high diagnostics value and they could be used in medical practice.

Besides, this approach could be applied for a study of some other neurological diseases.

References

1. Barkat-Defradas, M., Motte-Florac, E.: Words for odours: Language skills and cultural insights. Cambridge Scholars Publishing (2016)
2. Krismer, F., Pinter, B., Mueller, C., et al.: Sniffing the diagnosis: olfactory testing in neurodegenerative parkinsonism. Parkinsonism & related disorders 35 (2017) 36–41
3. Lawton, M., Hu, M.T., Baig, F., et al.: Equating scores of the university of pennsylvania smell identification test and sniffin'sticks test in patients with Parkinson's disease. Parkinsonism & related disorders 33 (2016) 96–101
4. Sorokowska, A., Albrecht, E., Haehner, A., Hummel, T.: Extended version of the "sniffin'sticks" identification test: Test–retest reliability and validity. Journal of neuroscience methods 243 (2015) 111–114 11. Lefebvre, V.A.: Algebra of conscience. Volume 30. Springer Science & Business Media (2013)